International Journal of Public Health Science (IJPHS)
Vol. 14, No. 3, September 2025, pp. 1387~1393
ISSN: 2252-8806, DOI: 10.11591/ijphs.v14i3.25308

Attitude as a mediator between socio-ecological factors and non-communicable disease management: a study protocol

Azrin Shah Abu Bakar[1], Haliza Abdul Rahman[1,2], Ahmad Iqmer Nashriq Mohd Nazan[3]
[1]Department of Environmental and Occupational Health, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, Selangor, Malaysia
[2]Institute for Social Science Studies, Universiti Putra Malaysia, Selangor, Malaysia
[3]Department of Community Health, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, Selangor, Malaysia

Article Info

Article history:

Received Jun 7, 2024
Revised Nov 12, 2024
Accepted Dec 13, 2024

Keywords:

Attitude
Mediation
Non-communicable disease
Management
Socio-ecological factors
Support staff

ABSTRACT

Non-communicable diseases (NCDs) have risen in Malaysia, and people with low socioeconomic status are more vulnerable to NCDs. Previous studies on the management of non-communicable disease have focused on aspects of socioeconomic factors, individual factors, and psychosocial factors. However, there is limited information on socio-ecological factors (e.g. intrapersonal, interpersonal, organizational, community, and societal factors) and their direct and indirect effect of socio-ecological factors on non-communicable disease management mediated by attitude has not been investigated. Thus, this study aimed to investigate the role of attitude as a mediator between socio-ecological factors and non-communicable disease management among support staff in Putrajaya, Malaysia. A cross-sectional study using cluster random sampling will be conducted at selected Ministries, in Putrajaya Malaysia. The questionnaire will assess respondents' background information, knowledge of non-communicable disease, attitude towards preventing non-communicable disease and chronic illness resources survey (CIRS) to measure socio-ecological factors. Descriptive and inferential statistics will be used in data analysis using SPSS and SEM with AMOS software. The findings will provide a theoretical model for understanding the various factors that determine towards non-communicable disease management through mediation of attitude.

Corresponding Author:

Haliza Abdul Rahman
Department of Environmental and Occupational Health, Faculty of Medicine and Health Sciences
Universiti Putra Malaysia
Serdang-43400, Selangor, Malaysia
Email: dr.haliza@upm.edu.my

1. INTRODUCTION

Non-communicable diseases (NCDs) are dangerous to human due to their potential causes of morbidity and mortality. It accounts for 74% of all deaths worldwide [1]. Malaysia is among the countries experiencing epidemiological transition, rapid economic development, population aging, and lifestyle changes resulting in an increased rate of NCD [1]. It has become the leading cause of 67% of deaths for people in Malaysia before 'premature deaths' (30-70 years) [2]. According to the National Health and Morbidity Survey (NHMS), over 70% of adult Malaysians are living with heart disease, diabetes, and cancer and account for 73% of deaths in Malaysia [2], [3]. Likewise, an estimated 240 million people living with NCD and 4.9 million deaths due to NCD [4]. Thus, this highlights the global burden of NCDs as one of the challenges in providing health treatment system, care, and support [5].

In Malaysia, the prevalence of NCD keeps rising, especially among low-income groups compared to other income groups [6]. The prevalence of hypertension and diabetes are more prevalent among the bottom (B40) than other income groups as reported by NHMS 2019 [7]. NHMS 2015 also showed similar findings, with the prevalence of raised hypertension and diabetes among low-income group [2]. The statistics illustrated that the prevalence of NCD among low-income workers has now reached an alarming level in Malaysia. The rise in prevalence of NCD among low-income groups will increase the risk of health problems, and it may be at higher risk of mortality, morbidity, and disability. This situation has a negative effect on the quality of life, productivity level, decreases in individual family-related quality of life, increased medical expenditure, and critically increased the country's economic burden [8], [9].

Previous studies have found that people of low socioeconomic status face limited access to policies, legislation, regulations, and healthcare services, whereby exposure to NCD is prevalent [10]. Indeed, the increase in healthcare costs reduces the ability to pay for medical expenses, which increases the risk of NCD [11]. Besides that, it was reported that lower socioeconomic status is often associated with having high rates of chronic disease, high morbidity and mortality, and lower life expectancy compared to high-income groups due to a lack of access to good health care and the need for social protection [10], [12]. Apart from that, they often do not have enough facilities (i.e. living conditions, physical safety, and healthy food) which play an essential role in developing NCD [13]-[15]. Meanwhile, the urban poor are at risk and more exposed to the danger of NCD compared to other people living in the city as they have a lack of knowledge, limitations in health information, fewer resources for treatment and health care as well as limited sources of income. This exposure leads them to adopt an urban lifestyle and turn puts them at a higher risk of getting NCD as well as worsens their condition [16]. Moreover, poverty and the level of development, especially in an area or country where urbanization is contributing to the increase in chronic diseases [17]. Furthermore, prolonged exposure to health-risk behaviors such as urbanization, poverty, lack of access to healthcare facilities, risky behaviors, use of tobacco products, unhealthy eating, physical inactivity, and being overweight or obese can affect their health and amplify the risk of chronic disease [18]. Perhaps not surprisingly, low-income workers also exposed to physical and psychosocial risks at the workplace which has contributed to a higher incidence of chronic diseases [18], [19]. Ultimately, low-income groups tend to face various factors such as social, workplace, community, and environment due to the lack of sufficient resources in dealing with health problems and non-communicable diseases [18], [20].

In this regard, non-communicable disease management plays a vital role in dealing with these diseases to improve health outcomes. Understanding factors that contribute to improving the care and management of NCD is important, as lower-income households are most vulnerable to NCD. Nevertheless, little is known about the management of non-communicable diseases among low-income workers. Furthermore, only a few studies have examined the role of contextual factors in chronic disease management [21]. Previous studies have found an association between self-management of non-communicable diseases with age [22] gender [22] education level [23], low socio-economic status [24], depression and anxiety [22], [25], [26], multi-morbidity [22], disease characteristics [23], disease duration, disease severity [22], illness perception [26], health literacy [24] and social support [27]. However, there are still limited studies exploring needs beyond individual factors that predict non-communicable disease management using the socio-ecological model that have not been clearly revealed. Apart from that, there is a limited holistic model or multilevel approach within the health promotion field [28]. Furthermore, the role of attitude as a mediator was limited in studying the mediating effect of attitude in a given relationship toward preventive health promotion behavior [29], [30]. Attitude is crucial in motivating individuals to be more likely to act or behavioral. It is the ability to encourage a responsible motivation for action. A positive attitude can impact motivation to follow the management of the disease. This positive attitude also enhances their motivation to manage health effectively. Conversely, negative attitudes can be barriers that decrease the ability to produce motivation or good results in the management of non-communicable diseases. Therefore, an attitude can improve or decrease motivation by influencing individuals towards the management of non-communicable diseases or vice versa. Likewise, attitudes can be used as a mediator in controlling the relationship between the two variables. This study aims to determine the role of attitudes as a mediator between socio-ecological factors and non-communicable disease management among low-income workers in Malaysia.

2. METHOD

2.1. Study location

This study will be carried out at the Ministries in Putrajaya, Malaysia. Putrajaya has 23 ministries, and the location was chosen because it is the federal government's administrative center, representing the largest number of civil servants in Malaysia. The NMHS revealed that civil servants in Putrajaya experienced an increase in obesity from 2015 to 2019, from 40.3% to 41.4% [2], [7]. Hence, it has put almost half of the

adult population in Putrajaya which consists of government employees, in the overweight or obese. Since most of the population consists of working adults, this increase in obesity is an early warning risk factor for NCDs [31].

2.2. Study design and study population

This study employs a cross-sectional study that aims to determine the mediating role of attitude in the relationships between socio-ecological factors and non-communicable disease management among support staff in Putrajaya, Malaysia. The target population is support staff members. The respondents will be chosen using cluster random sampling where eight out of 23 ministries in Putrajaya were randomly selected using a table of random number. The inclusion criteria are permanent staff aged 18 years old and above. The exclusion criterion is contract or part-time staff. All support staff who meet the inclusion criteria will be approached for participation in this study.

2.3. Data collection procedure

Before distributing the questionnaire, those who fulfilled the inclusion criteria will be informed about the research procedure. Then the questionnaire, and consent form will be distributed to the respondents and administered via an office in charge or representatives from selected ministries through email and WhatsApp which will then be sent weekly as reminders to the respondents.

2.4. Sample size

The minimum sample size required for this study was calculated using an online calculator [32] by setting the anticipated effect size f2 = 0.3, the desired p-value was at 0.05, the desired statistical power level at 80%, the number of observed variables was 94 and the number of latent variables was 12 is 200, and the final sample size after accounting for a non-response rate 80% is 360.

2.5. Study instruments

This study instrument comprises four sections which include socio-demographic information, knowledge of non-communicable diseases, attitudes towards preventing non-communicable diseases, and the chronic illness resources survey (CIRS). The questionnaire will be modified and adapted from [33], [34]. Section A consists of socio-demographic information including age, gender, race, marital status, educational level, and monthly household income. Section B assesses the respondents' knowledge of non-communicable diseases, the knowledge questions cover the understanding of non-communicable diseases including the major non-communicable diseases which are cardiovascular disease, stroke and hypertension, diabetes mellitus, and chronic obstructive pulmonary disease as well as risk factors, complications and disease management. Respondent will be instructed to give a 'yes', 'not' and 'do not know'. The level of knowledge will be categorized as having good knowledge, moderate knowledge and poor knowledge. It had excellent internal consistency reliability (Cronbach's $\alpha = 0.961$). Section C consists of 15 items for the attitude towards preventing non-communicable diseases, which including balanced diet, physical activity, smoking, salt intake, medication intake, and treatment checks. The questions are evaluated using a 5-point Likert scale ranging from 'Strongly disagree', 'disagree', 'agree' and 'strongly agree'. All results will be discussed by descriptive data analysis. In this study, the survey showed good internal consistency reliability (Cronbach's $\alpha = 0.898$). Section D will be the final section of the questionnaire containing 65 items for chronic illness resources survey (CIRS) to assess the socio-ecological factors, divided into five sub-scales that measures interpersonal, organizational, community, societal, self-management of disease. The questionnaire is based on a 5-point Likert scale as either 'Not at all', 'A little', 'Moderate', 'Quite a lot' and 'A great deal'. In this study, the CIRS showed good internal consistency reliability (Cronbach's $\alpha = 0.90$).

2.6. Data analysis

Data will be analyzed using the statistical package for social science (SPSS) and structural equation model (SEM) using AMOS. Descriptive analysis will be performed to measure all variables. SEM will be applied in the inferential method to test the hypothesized model and confirm the relationship modeling with three stages, which are confirmatory factor analysis (CFA), measurement model, and structure model. Then, bootstrapping analysis will be used to test the mediation effect. The significance level will be set at $p<0.05$.

3. DISCUSSION

This study will examine the relationship between socio-ecological factors and management of non-communicable disease as well as understanding the mediating role of attitudes. The finding will investigate whether socio-ecological factors (i.e., intrapersonal, interpersonal, organizational, community, and societal factors) help to influence non-communicable disease management through attitude as the mediator. In other

words, socio-ecological factors whether the direct and indirect influence on non-communicable disease in presence of attitudes as a mediating variable. This evidence is necessary to determine whether attitude mediates the relationship between socio-ecological factors and non-communicable disease management.

A study conducted locally among public service employees in Putrajaya, Malaysia found that 77.8% were obesity and 44.7% had high blood pressure among the implementer group compared to the professional and management group [35]. This shows that low-income workers are more likely to suffer chronic diseases as compared to high-income group [36]. Therefore, non-communicable disease management is increasingly recognized as important for the working age group, the prevalence of chronic conditions, and the importance of maintaining productive and competitive employees [37]. Applying the management of chronic disease in daily life plays a pivotal role in dealing with the diseases, improving health, and quality of life [38]. This study emphasizes the importance of non-communicable disease management to prevent and reduce NCD among low-income workers.

Non-communicable disease management among low-income workers in Malaysia has been limited. Also, understanding the issues relating to non-communicable disease management and socioecological framework applications within the health promotion field is still limited [28]. To achieve this goal, direct and indirect effect of intrapersonal, interpersonal, organizational, community, and societal factors on non-communicable disease management through attitudes will be measured using structural equation modeling to confirm the relationship modeling. SEM by McLeroy *et al.* [39] is used as a theoretical framework to explain the influential factors towards non-communicable disease management. Prior research has used SEM model to investigate the potential determinants of health [40]. A comparison of several theories and models that explain health behavior such as health belief model (HBM), theory of reasoned action (TRA), an extension of the theory of planned behavior (TPB), and social cognitive theory (SCT) has focused on individual (intrapersonal) and personal, behavior and environmental (interpersonal) factors rather than taking into account a broader or holistic perspective [41]. Researchers claim that these psychological theories emphasize the individual by not examining the wider health behavior environment [42], [43]. According to Flay *et al.* [44], the theories above are more suitable for investigating single influential factors involving proximal and distal factors, but not combining two or three factors. Hence, this SEM model was chosen because it is a comprehensive model that integrates multiple levels of influence that interact in a bounded manner (dynamic transactions) within the scope of human life in the environment helping to determine a person's health behavior.

The bulk of the literature suggested that the SEM model allows for the understanding of influences that can impact health outcomes, reducing disease risks, particularly among vulnerable population groups [45], [46]. In addition, this SEM model can provide a good understanding of the influence of health behavior to reduce health inequalities among low-income workers [18]. A study by Watts *et al.* [47] has used the SEM model to promote health in the workplace. However, it was found that there is still a limited number of studies that combines various factors for the study of employee behavior in the national context in Malaysia. Thus, this study proposes that socio-ecological factors may help in managing non-communicable disease. The prioritization of the socio-ecological factors is crucial for ensuring these factors contribute to the management of non-communicable disease. Understanding these factors affecting the management of non-communicable diseases would also offer or plan useful opportunities in developing appropriate intervention studies based on considering these factors to include a more holistic program to improve the preventive behavior towards non-communicable disease management among low-income workers in Malaysia. Hence, the SEM model would seem to be suited to this study as the basis of the behavior model needed for applications for research and intervention.

This study further highlights the potential findings that can be useful to relevant stakeholders including the government, policymakers, and health professionals in understanding the problem, solving it, and developing plans, strategies, and policies that focus on chronic disease to reduce morbidity and mortality in Malaysia. In addition, the findings of this study can be used by future researchers, healthcare professionals, and program managers to implement and develop future interventions for low-income workers in Malaysia. Furthermore, this study will get a better understanding of the factors influencing the management of non-communicable disease in Malaysia, especially among low-income workers in Malaysia to strengthen the strategies focused to reduce the risk of NCDs, as well as reduce morbidity and mortality in Malaysia. The emphasis on non-communicable disease management is important in maintaining work performance, productivity, and health, improving quality of life, and longer life expectancy. Moreover, low-income workers are also at an important stage of development as the main driving force of the country's economy and productivity in helping the management or the authorities maintain and improve the quality of services [47]-[49].

4. CONCLUSION

This study will provide new insight regarding non-communicable disease management. Additionally, understanding these factors that influence non-communicable disease management in this study could contribute to the body of knowledge. Moreover, this study provides evidence-based new insights into the literature on attitudes as mediators in the relationship between socio-ecological factors and non-communicable disease management. It is hoped that the findings of this study can validate a theoretical model to explain attitudes acting as a mediator between socio-ecological factors and non-communicable disease management.

There are some limitations in this study that should be noted. The generalization may be limited because it will be conducted within Putrajaya, which does not represent the whole population of low-income workers in Malaysia. Furthermore, it should also be noted that the questionnaire used is based on self-reporting, which may chance of recall bias. Nevertheless, to the best of our knowledge, this is the first study to investigate the role of attitudes as a mediator in the relationships between socio-ecological factors and non-communicable disease management. Furthermore, relevant stakeholders such as government, policymakers, and health professionals can utilize these findings to develop future interventions.

ETHICAL APPROVAL

This study was approved by the Ethics Committee for Research Involving Human Subjects of Univeristi Putra Malaysia (JKEUPM) with reference number (JKEUPM-2024-301).

REFERENCES

[1] WHO, "Noncommunicable diseases progress monitor 2022," *World Health Organization*, 2022. https://www.who.int/publications-detail-redirect/9789240047761 (accessed: Jan 13, 2024).

[2] Institute for Public Health Ministry of Health Malaysia, "Malaysian burden of disease and injury study 2009-2014," 2017. http://iku.moh.gov.my/images/IKU/Document/REPORT/BOD/BOD2009-2014.pdf (accessed: Jan 13, 2024).

[3] S. Yasin, C. K. Chan, D. D. Reidpath, and P. Allotey, "Contextualizing chronicity: a perspective from Malaysia," *Globalization and Health*, vol. 8, no. 1, p. 4, 2012, doi: 10.1186/1744-8603-8-4.

[4] M. M. Hassan, M. H. Tahir, M. Ameeq, F. Jamal, J. T. Mendy, and C. Chesneau, "Risk factors identification of COVID-19 patients with chronic obstructive pulmonary disease: A retrospective study in Punjab-Pakistan," *Immunity, Inflammation and Disease*, vol. 11, no. 8, Aug. 2023, doi: 10.1002/iid3.981.

[5] J. Thakur, S. Prinja, C. Garg, S. Mendis, and N. Menabde, "Social and economic implications of noncommunicable diseases in india," *Indian Journal of Community Medicine*, vol. 36, no. 5, p. 13, 2011, doi: 10.4103/0970-0218.94704.

[6] A. S. Bin Abu Bakar, H. Abdul Rahman, A. I. N. Mohd Nazan, and H. K. Shahar, "Understanding the determinant factors of chronic disease behaviour among Malaysian low-income workers: An integrated model approach," *International Journal of Academic Research in Business and Social Sciences*, vol. 12, no. 14, Dec. 2022, doi: 10.6007/IJARBSS/v12-i14/15826.

[7] National Institutes of Health, "National health and morbidity survey 2019 (NHMS 2019): Non-communicable diseases, healthcare demand, and health literacy—key findings," 2019. [Online]. Available: https://iptk.moh.gov.my/images/technical_report/2020/4_Infographic_Booklet_NHMS_2019_-_English.pdf (accessed: Jan 13, 2024).

[8] D. Bloom, E. T. Cafiero-Fonseca, E. J. Llopis, S. Abrahams-Gessel, J. Weiss, and E. Al., *The global economic burden of noncommunicable diseases*, 2012. [Online]. Available: https://www3.weforum.org/docs/WEF_Harvard_HE_GlobalEconomicBurdenNonCommunicableDiseases_2011.pdf (accessed: Jan 13, 2024).

[9] The World Health Organization (WHO), "Noncommunicable diseases country profiles 2018," *World Health Organization*, 2018. https://www.who.int/nmh/publications/ncd-profiles-2018/en/ (accessed: Jan 13, 2024).

[10] W.-Y. Low, Y.-K. Lee, and A. L. Samy, "Non-communicable diseases in the Asia-Pacific region: Prevalence, risk factors and community-based prevention," *International Journal of Occupational Medicine and Environmental Health*, Dec. 2014, doi: 10.2478/s13382-014-0326-0.

[11] M. Muneeb Hassan, M. Ameeq, F. Jamal, M. H. Tahir, and J. T. Mendy, "Prevalence of COVID-19 among patients with chronic obstructive pulmonary disease and tuberculosis," *Annals of Medicine*, vol. 55, no. 1, pp. 285–291, Dec. 2023, doi: 10.1080/07853890.2022.2160491.

[12] Rockefeller, "Health vulnerabilities of informal workers," *Innovation for The Next 1000 years*, 2013. https://assets.rockefellerfoundation.org/app/uploads/20130528214745/Health-Vulnerabilities-of-Informal-Workers.pdf (accessed: Jan 13, 2024).

[13] S. Stringhini *et al.*, "Socioeconomic status and the 25 × 25 risk factors as determinants of premature mortality: a multicohort study and meta-analysis of 1·7 million men and women," *The Lancet*, vol. 389, no. 10075, pp. 1229–1237, Mar. 2017, doi: 10.1016/S0140-6736(16)32380-7.

[14] M. S. Mujahid *et al.*, "Neighborhood characteristics and hypertension," *Epidemiology*, vol. 19, no. 4, pp. 590–598, Jul. 2008, doi: 10.1097/EDE.0b013e3181772cb2.

[15] S. H. Woolf, M. M. Dekker, F. R. Byrne, and W. D. Miller, "Citizen-centered health promotion: building collaborations to facilitate healthy living," *American Journal of Preventive Medicine*, vol. 40, no. 1, pp. S38–S47, Jan. 2011, doi: 10.1016/j.amepre.2010.09.025.

[16] A. K. *et al.*, "Are the urban poor vulnerable to non-communicable diseases? A survey of risk factors for non-communicable diseases in urban slums of Faridabad," *National Medical Journal of India*, vol. 20, no. 3, pp. 115–120, 2007.

[17] R. Hami *et al.*, "Factors contributing to non-communicable diseases in a selected low socio-economic status community in Kedah, Malaysia," *Malaysian Journal of Medicine and Health Sciences*, vol. 17, no. 1, pp. 117–123, 2021.

[18] S. L. Baron *et al.*, "Promoting integrated approaches to reducing health inequities among low-income workers: Applying a social ecological framework," *American Journal of Industrial Medicine*, vol. 57, no. 5, pp. 539–556, May 2014, doi: 10.1002/ajim.22174.
[19] J. D. Meyer, "Race-based job discrimination, disparities in job control, and their joint effects on health," *American Journal of Industrial Medicine*, vol. 57, no. 5, pp. 587–595, May 2014, doi: 10.1002/ajim.22255.
[20] N. Gawde and P. Kurlikar, "Chronic disease risk factors among hotel workers," *Indian Journal of Occupational and Environmental Medicine*, vol. 20, no. 1, p. 14, 2016, doi: 10.4103/0019-5278.183830.
[21] J. K. Benzer *et al.*, "The relationship between organizational climate and quality of chronic disease management," *Health Services Research*, vol. 46, no. 3, pp. 691–711, Jun. 2011, doi: 10.1111/j.1475-6773.2010.01227.x.
[22] J. Cameron, L. Worrall-Carter, B. Riegel, S. K. Lo, and S. Stewart, "Testing a model of patient characteristics, psychologic status, and cognitive function as predictors of self-care in persons with chronic heart failure," *Heart & Lung*, vol. 38, no. 5, pp. 410–418, Sep. 2009, doi: 10.1016/j.hrtlng.2008.11.004.
[23] J. M. Rockwell and B. Riegel, "Predictors of self-care in persons with heart failure," *Heart & Lung*, vol. 30, no. 1, pp. 18–25, Jan. 2001, doi: 10.1067/mhl.2001.112503.
[24] R. T. Disler, R. D. Gallagher, and P. M. Davidson, "Factors influencing self-management in chronic obstructive pulmonary disease: An integrative review," *International Journal of Nursing Studies*, vol. 49, no. 2, Feb. 2012, doi: 10.1016/j.ijnurstu.2011.11.005.
[25] M. Rose, H. Fliege, M. Hildebrandt, T. Schirop, and B. F. Klapp, "The network of psychological variables in patients with diabetes and their importance for quality of life and metabolic control," *Diabetes Care*, vol. 25, no. 1, pp. 35–42, Jan. 2002, doi: 10.2337/diacare.25.1.35.
[26] C. E. Connelly, "An empirical study of a model of self-care in chronic illness," *Clinical Nurse Specialist*, vol. 7, no. 5, pp. 247–253, Sep. 1993, doi: 10.1097/00002800-199309000-00007.
[27] M. P. Gallant, "The influence of social support on chronic illness self-management: A review and directions for research," *Health Education & Behavior*, vol. 30, no. 2, pp. 170–195, Apr. 2003, doi: 10.1177/1090198102251030.
[28] S. D. Golden and J. A. L. Earp, "Social ecological approaches to individuals and their contexts," *Health Education & Behavior*, vol. 39, no. 3, pp. 364–372, Jun. 2012, doi: 10.1177/1090198111418634.
[29] M. R., Y. R., and Y. H.M., "Knowledge, attitude and practice on cardiovascular disease among women in North-Eastcoast Malaysia," *International Journal of Collaborative Research on Internal Medicine and Public Health*, vol. 4, no. 1, pp. 85–98, 2012.
[30] E. B. Lynch, K. Liu, C. I. Kiefe, and P. Greenland, "Cardiovascular disease risk factor knowledge in young adults and 10-year change in risk factors: The Coronary Artery Risk Development in Young Adults (CARDIA) Study," *American Journal of Epidemiology*, vol. 164, no. 12, pp. 1171–1179, 2006, doi: 10.1093/aje/kwj334.
[31] World Health Organization, "Noncommunicable diseases," *World Health Organization*, 2018.
[32] D. S. Soper, "A-priori sample size calculator for structural equation Models [Software]," *Available from http://www.danielsoper.com/statcalc*, 2019.
[33] M. Ithnin *et al.*, "Knowledge, attitude, and practice on non-communicable diseases (NCDs) among the adult population in the urban area of Negeri Sembilan, Malaysia," *International Journal of Research in Pharmaceutical Sciences*, vol. 9, no. Special Issue 2, pp. 88–94, 2018, doi: 10.26452/ijrps.v9iSPL2.1747.
[34] R. E. Glasgow, L. A. Strycker, D. J. Toobert, and E. Eakin, "A social-ecologic approach to assessing support for disease self-management: The Chronic Illness Resources Survey," *Journal of Behavioral Medicine*, vol. 23, no. 6, pp. 559–583, 2000, doi: 10.1023/A:1005507603901.
[35] H. P. Chee, A. S. Hazizi, M. Y. Barakatun Nisak, and M. T. Mohd Nasir, "Metabolic risk factors among government employees in Putrajaya, Malaysia," *Sains Malaysiana*, vol. 43, no. 8, pp. 1165–1174, 2014.
[36] H. A. Rahman, A. S. A. Bakar, H. K. Shahar, and A. I. N. M. Nazan, "A review on the factors contributing to non-communicable disease (NCD) among low-wage workers," *Malaysian Journal of Medicine and Health Sciences*, vol. 17, pp. 239–247, 2021.
[37] A. S. Bin Abu Bakar, H. Abdul Rahman, A. I. N. Mohd Nazan, and H. K. Shahar, "Understanding the determinant factors of chronic disease behaviour among Malaysian low-income workers: An integrated model approach," *International Journal of Academic Research in Business and Social Sciences*, vol. 12, no. 14, 2022, doi: 10.6007/ijarbss/v12-i14/15826.
[38] A. S. Abu Bakar, H. Abdul Rahman, H. Kadir Shahar, A. I. N. Mohd Nazan, and K. Idris, "Chronic disease management behaviours among Malaysian low-income workers: a descriptive study," *Asian Journal of Medicine and Biomedicine*, vol. 6, no. S1, pp. 101–103, 2022, doi: 10.37231/ajmb.2022.6.s1.545.
[39] K. R. McLeroy, D. Bibeau, A. Steckler, and K. Glanz, "An ecological perspective on health promotion programs," *Health Education Quarterly*, vol. 15, no. 4, pp. 351–377, Dec. 1988, doi: 10.1177/109019818801500401.
[40] M. M. Hassan *et al.*, "Assessing socio-ecological factors on caesarean section and vaginal delivery: an extended perspective among women of South-Punjab, Pakistan," *Journal of Psychosomatic Obstetrics & Gynecology*, vol. 44, no. 1, Dec. 2023, doi: 10.1080/0167482X.2023.2252983.
[41] S. Piscopo, "Socio-ecological factors influencing food choices and behaviours of Maltese primary schoolchildren," Thesis, The University of Birmingham, 2004.
[42] B. Giles-Corti and R. J. Donovan, "The relative influence of individual, social and physical environment determinants of physical activity," *Social Science & Medicine*, vol. 54, no. 12, pp. 1793–1812, Jun. 2002, doi: 10.1016/S0277-9536(01)00150-2.
[43] D. Stokols, "Translating social ecological theory into guidelines for community health promotion," *American Journal of Health Promotion*, vol. 10, no. 4, pp. 282–298, Mar. 1996, doi: 10.4278/0890-1171-10.4.282.
[44] B. R. Flay, F. J. Snyder, and J. Petraitis, *The theory of triadic influence*. 2009.
[45] J. G. Oetzel, S. Ting-Toomey, and S. Rinderle, "Conflict communication in contexts: A social ecological perspective," *The SAGE Handbook of Conflict Communication: Integrating Theory, Research, and Practice*, 2006, doi: 10.4135/9781412976176.n26.
[46] J. Gregson *et al.*, "System, environmental, and policy changes: Using the social-ecological model as a framework for evaluating nutrition education and social marketing programs with low-income audiences," *Journal of Nutrition Education*, vol. 33, pp. S4–S15, Sep. 2001, doi: 10.1016/S1499-4046(06)60065-1.
[47] G. F. Watts, R. E. Donahue, J. M. Eddy, and E. V Wallace, "Use of an ecological approach to worksite health promotion," *American Journal of Health Studies*, vol. 17, no. 3, p. 144, 2001.
[48] A. S. Bin Abu Bakar, H. Abdul Rahman, H. K. Shahar, A. I. N. M. Nazan, and K. Idris, "A conceptual framework of factors influencing prevention-related practice behaviors towards non-communicable diseases (NCDs) of Low-Income Workers," *International Journal of Academic Research in Business and Social Sciences*, vol. 10, no. 16, Nov. 2020, doi: 10.6007/IJARBSS/v10-i16/8290.
[49] A. S. Abu Bakar *et al.*, "Predictor of non-communicable disease management behaviour among support staff in selected ministries in Malaysia," *Azerbaijan Medical Journal*, vol. 62, no. 10, pp. 6369–6379, 2022.

BIOGRAPHIES OF AUTHORS

Azrin Shah Abu Bakar is a Ph.D. student at the Faculty of Medicine and Health Sciences, Universiti Putra Malaysia. His research areas on occupational health and chronic disease prevention. He has published several research papers and conference papers. He can be contacted at email: gs67640@student.edu.my.

Haliza Abdul Rahman is an Associate Professor at Faculty of Medicine and Health Sciences, Universiti Putra Malaysia. Currently, she is Head of Laboratory of Youth in Leadership, Politics & Citizenship at Institute for Social Science Studies, Universiti Putra Malaysia. Her research areas on environmental governance, public involvement in environmental issues, and environmental managements. She has authored 20 academic books and articles in various journals. She can be contacted at email: dr.haliza@upm.edu.my.

Ahmad Iqmer Nashriq Mohd Nazan is a senior lecturer at Faculty of Medicine and Health Sciences, Universiti Putra Malaysia. His research areas on community and behavioral health promotion, social network and integration. He is also interested in educational statistics and measurement. The findings of his studies have been published in referred journals, as well as, presented at various conferences. He can be contacted at email: iqmernashriq@upm.edu.my.